

**FORMING AN OPTICAL ELEMENT ON THE SURFACE OF A LIGHT
EMITTING DEVICE FOR IMPROVED LIGHT EXTRACTION**

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ABSTRACT OF THE DISCLOSURE

10 Provided is a light emitting device including a Fresnel lens and/or a holographic
diffuser formed on a surface of a semiconductor light emitter for improved light
extraction, and a method for forming such light emitting device. Also provided is a light
emitting device including an optical element stamped on a surface for improved light
15 extraction and the stamping method used to form such device. An optical element
formed on the surface of a semiconductor light emitter reduces reflective loss and loss
due to total internal reflection, thereby improving light extraction efficiency. A Fresnel
lens or a holographic diffuser may be formed on a surface by wet chemical etching or dry
etching techniques, such as plasma etching, reactive ion etching, and chemically-assisted
20 ion beam etching, optionally in conjunction with a lithographic technique. In addition, a
Fresnel lens or a holographic diffuser may be milled, scribed, or ablated into the surface.
Stamping, an alternative method for forming an optical element, can also be used to form
a Fresnel lens or a holographic diffuser on the surface of a semiconductor light emitter.
Stamping includes pressing a stamping block against the surface of a light emitting diode.
The stamping block has a shape and pattern that are the inverse of the desired optical
25 element. Optionally, stamping can be done before, after, or concurrently with wafer-
bonding. Alternatively, a material can be stamped and later bonded to the semiconductor
light emitter.